257252

Freeman, Cheryl RSPA-01-9731-8 Additional Info. E 12/06.

From: Ola.Johnsrud@raufoss.com
Sent: Monday, October 29, 2001 9:03 AM
To: cheryl.freeman@rspa.dot.gov
Cc: Rune.Ulekleiv@raufoss.com; atitest@pe.net; raymondbeaudoin@hotmail.com
Subject: Raufoss Composites AS - LPG composite cylinder - Proposal for exemption

Dear Ms Freeman,

Please find enclosed the RAC proposal for exemption text. The technical details are based on FRP-1, the text is based on an exemption copy received from ATI.

Also enclosed (for information only), please find a document with comments to the exemption text proposal, including references to the FRP-1, ISO/DIS 11119-3 and special aspects to the actual product.

We are of-course very interested in being a part of further discussions together with you. Please, don't hesitate to contact us.

Best regards
Ola Johnsrud

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RAUFOSS COMPOSITES

FRP-1 summary and comments

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This document is a working (living) document for RAC during the exemption process for 10kg LPG composite cylinder (CompLet) - it should be regared as information only. It referres to items in FRP-1 standard. Comments are given where special focus or differences should be pointed out, due to FRP-1 originally being designed for Alu-liner (++) and other user applications than CompLet. The document will be updated during the co-operation with DOT. RAC ask readers to please excuse spelling mistakes and poor language....

Item name	FRP-1, 178.AA-X	ISO/DIS 11439, sec: 8.5.x	Equal to original FRP-1?	Standard description	Comments
General	1	NA	Yes	XXX	NA
Type, size and service pressure	2	NA	No	Type 4FC cylinder consisting of resin impregnated continuous filament windings in both longitudinal and circumferential directions only over thermoplastic liner; with a water capacity less than 60 Liters (132Lbs); a defined service pressure 20bars (294psi), test pressure for hydrostatic proof testing at 30bars (441psi) and a required burst pressure (=design pressure) > 60bars (882psi).	The cylinder has got a non-load sharing, blow molded, seamless thermoplastic liner instead of a aluminum liner. No requirements related aluminim liner are valid
Inspection by whom and where	3	NA	Yes	XXX	
Duties of the inspector	4a	NA	No	Determine that all all materials conform to the provisions of FRP-1 and the exemption DOT-E 12706.	
Duties of the inspector	4b	NA	No	For each raw material batch, verify liner material to be within the specification in this exemption by analyses or obtaining the manufacturers certified analyses. A certification from the manufacturer is acceptable when verified by check analyses on a sample from every raw material batch. Verify conformance of filament and resin system components with the requirements in§178.AA-5	*Instead of defining linerlots from a non-scientific* number (200), the group should cover liners from equal rawmaterialbatch and equal manufacturig parameters registrerd.
Duties of the inspector	4c	NA	Yes	XXX	
Duties of the inspector	4d	NA	No	The inspector shall verify conformance of completed cylinder with all requirements, including marking, condition of inside, threads and relevant process parameters.	Several parameters are registered from the manufacturing - not only heat treatment. Heat treatment of liner is more important for a Alu-liner than a thermoplastic liner.
Duties of the inspector	4e	NA	Yes	XXX	
Duties of the inspector	4f	NA	No	Inspect and confirm that the manufacturer store all basis data for the above mentioned parameters. This includes material details (see §§ (b)), batch test results *(se §§ (d)), and individual process data (see §§ (e)).*	The inspections sohuld focus on the manufacturing- and quality system
Duties of the inspector	4g	NA	Yes		
Authorized material and identification of material	5a	NA	No	Liner material must be thermoplastic of blow molding quality	
Authorized material and identification of material	5b	NA	Yes	XXX	
Authorized material and identification of material	5c	NA	No	Resin must be based on a thermoset resin as described in the material specifications. Resin system must be tested on sample coupons representative of the composite over-wrap in accordance with ASTM D-2344-67 for water boil test, and have minimum shear *strength of 13,8MPa (2029psi) (Comment: law ISOXX).*	The original requirement is related to epoxy based resins, not polyester / vinyl ester as covered by this exemption. Also, the requirement is originally designed for an high pressure application, not LPG.
Authorized material and identification of material	5d	NA	Yes	XXX	
Authorized material and identification of material	5e	NA	Yes	XXX	
Manufacture	6a	NA	No	Liner: The thermoplastic liner shall be homogeneous, clean and correctly dimensioned. No defect that is likely to weaken the finished liner function, is authorized. Liner: The thermoplastic liner shall be homogeneous, clean and correctly dimensioned. No defect that is likely to weaken the finished liner function is authorized. To determine liner properties, main process parameters defined by the *manufacturer shall be continuously monitored and logged.*	Thermoplastic non-load sharing liner instead of an aluminum
Manufacture	6b	NA	No	Composite cylinder must be manufactured from a thermoplastic .... (text as FRP-1) .... temperature profile. No defect that is likely to weaken the finished cylinder appreciably is acceptable.	Thermoplastic non-load sharing liner instead of an aluminum
Manufacture	6c	NA	Yes	XXX	
Manufacture	6d1	NA	Yes	XXX	
Manufacture	6d2	NA	No	Composite cylinder lot size: ...(text as in FRp-1)... same cylinder specification.	Thermoplastic non-load sharing liner instead of an aluminum
Manufacture	6d3	NA	Yes	XXX	
Manufacture	6e	NA	Yes	XXX	
Wall thickness	7a	NA	No	Liner wall thickness shall be within tolerances specified in technical base for the product (= drawings).	*Thermoplastic non-load sharing liner instead of an aluminum*
Wall thickness	7b	NA	Yes	XXX	
Wall thickness	7c	NA	Yes	XXX	
Wall thickness	7d	NA	Yes	XXX	
Openings	8a	NA	Yes	XXX	
Openings	8b	NA	Yes	XXX	
Openings	*8c*	NA	*No*	If using tapered threads, the connection must be secured with a suitable tightening fluid. If using cylindrical threads, the integrity of the threads, cylinder neck and boss/liner attachment shall be tested by applying 1,5 times the force specified in a relevant standard or by the manufacturer. No significant permanent damage to the threads, neck or boss/liner should be seen.	The cylinder is meant for a low pressure market only, where tapered threads are the most commonly used. The test basically described is defined in *CEN 12245* and *ISO 11119-3*
Openings	8d	NA	Yes	XXX	
Thermal treatment	9a	NA	No	Not applicable, due to the use of a non-load sharing thermoplastic liner.	
Thermal treatment	9b	NA	Yes	XXX	
Pressure relief devices and protection ....connections	10	NA	Yes	XXX	

Item name	FRP-1, 178.AA-X	ISO/DIS 11439, sec. 8.5.x	Equal to original FRP-1?	Standard description	Comments
Non-destructive tests - hydrostatic test	11a1	1 and 2	No	Hydrostatic test: By water-jacket, air/gas-jacket, vision system or equivalent method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1% in the range of 80%-120% of test pressure. Expansion gauge must permit reading of total expansion to an accuracy of 1% of the water capacity. (from 13a: The permanent volumetric expansion of the cylinder must not exeed 5% of the total volumetic expansion at testpressure).	The composite cylinder will expand and decrease in volume more than a steel cylinder. The increase will be approximately linear to the pressure increase all the way to burst pressure. Due to the retraction and lack of auto-frettage, one find almost no permanent change in volume after proof test.
Non-destructive tests - hydrostatic test	11a2	1 and 2	No	The accuracy of the test equipment must be maintained by periodic recalibration. Records must be maintained to verify that the test equipment is calibrated on regular basis.	Due to using pressure indicators, normal calibration of these indicators should be sufficient to monitor equipment stability, even without running a test cylinder every day.
Non-destructive tests - hydrostatic test	11a3	1 and 2	Yes	XXX	
Non-destructive tests - hydrostatic test	11a4	1 and 2	No	Each cylinder must be tested to at least 30 bars	The relation between temperature and pressure indicates a pressure of approximately 8 bars when the liquids temperature is 25 dgrC and approximately 25bars when the temperature is 70dgrC. European regulations and ISO defines test pressure for the relevant gases to 30bars and a minimum burst pressure to 60bars. Experience shows that this is sufficient also for extreme hot climate countries.
Destructive tests - physical tests	12a	NA	No	During start of production one cylinder taken from approximately every 200 cylinder shall be controlled for main dimensions (including wall thickness), weight and integrity of the boss connection to liner. The sample rate may be decreased in steps to 1/5000 cylinders based on a skip-lot system and OK results.	Thermoplastic non-load sharing liner instead of an aluminum
Destructive tests - Cycling test	12b	4	No	- 1/1000 cylinder - 0-20 bars, 10000 cycles - 0-30 bars, 30 cycles - Max 4cycles/minute - Time/pressure curve to be reistered - Requirements from 13c: No evidence of distorsion or failure	law CEN 12245 and ISO11119-3). Typical results are 2 times the required number of cycles required in §178.AA-13c.
Destructive tests - Burst test	12c	3	Yes	- Controlled pressurisation in test rig - pressure/time rate, uniform, < 200psi/s (=13,6bar/s) - keep pressure at 60sec at 60bars - pressurisation until failure - burstpressure to be recorded - Requirements from 13d: Burst> 60 bars, start in sidewall, remain in one piece	
Acceptable results of tests - hydrostatic test	13a	NA	Yes	The permanent volumetric expansion of the cylinder must not exeed 5% of the total volumetic expansion at testpressure.	
Acceptable results of tests - physical test	13b	NA	Yes	XXX	Applies to aluminum liner only
Acceptable results of tests - cycling test	13c	NA	Yes	1 No evidence of distorsion or failure 2 If the test cylinder fails to meet requirements, the lot represented must be rejected.	
Acceptable results of tests - burst test	13d	NA	Yes	- Burst pressure must be > 60 bars - Burst should start in cylinder sidewall - Must remain in one piece - burst pressure to be recorded - If the testcylinder fails ....., the lot represented must be rejected.	
Rejected liners and cylinders - hydrostatical test	14a	NA	Yes	XXX	
Rejected liners and cylinders - physical test	14b	NA	Yes	XXX	
Rejected liners and cylinders - cycle test	14c	NA	Yes	XXX	
Rejected liners and cylinders - burst test	14d	NA	Yes	XXX	
Marking	15a	NA	No	Each cylinder must be permanently marked in accordance with 49 CFR §178.51	
Marking	15b	NA	No	Each cylinder must be permanently marked in accordance with 49 CFR §178.51	
Marking	15c	NA	Yes	XXX	
Marking	15d	NA	Yes	XXX	
Inspector's report	16	NA	No	The inspector must prepare a report that is clear, legible and covers the relevant parts and legally binding text detailed in the following forms: (see forms in FRP-1, §178.AA-16 Inspector's report).	
Retention of inspector's report	17	NA	Yes	XXX	
Design qualification tests - general	18a	NA	Yes	XXX	

This colour represents "during manufacturing tests"

Item name	FRP-1, 178.AA.X	ISO/DIS 11439, sec. 8.5.x	Equal to original FRP-1?	Standard description	Comments
Design qualification tests - design changes	18b	NA	No	.....in water capacity. Without changing the cylinder water capacity, an increase up to 50% in material thickness for structural related components (i.e. liner, composite overwrap, outer protection) may be implemented, resulting in he cylinder to be considered a equal product.	Increase in material wall thickness generally increases properties and should not be subject to sertification update.
Design qualification tests - test requirements	18c	NA	Yes	XXX	
Design qualification tests - cycling at ambient temperature	18d1	4	Yes	- 0-20 bars, 10000 cycles - Max 4cycles/minute - Time/pressure curve to be reistered - Requirement: No evidence of distortion, deterioration or failure - The cylinder to be submitted to test 18e1	
Design qualification tests - environmental cycling test	18d2	6	Yes	- One cylinder free of protective coating - Condition the cylinder for 48hours, 0 pressure, > 140dgrF (60dgrC), >95% RH - 0-20bars, 5000 cycles, >140dgrF (60dgrC), >95% RH - 0-20bars, 5000 cycles, < -50dgrF (-51 dgrC) - Stabilize at 0 pressure, ambient temperature and humidity - 0-30bars, ambient - Requirement: No evidence of distortion, deterioration or failure	
Design qualification tests - thermal cycling test	18d3	NA	Yes	- 0-20 bars, 10000 cycles - 0-30bars, 30 cycles - Time/pressure curve to be registered, also for the 20 cycles of "soaking" - Hydrostatically pressurize to 20bars - 20 cycles: - Submerge into 200dgrF (94dgrC) fluide for 10 minutes - transfertime 1-3 minutes - Submerge into -60dgrF (-51dgrC) fluide for 10 minutes - Requirement: No evidence of distortion, deterioration or failure - The cylinder to be submitted to test 18e1	
Design qualification tests - hydraulic burst test	18e	3	Yes	- Controlled pressurisation in test rig - pressure/time rate , uniform, < 200psi/s (=13,6bar/s) - keep pressure at 60sec at 60bars - pressurisation until failure - burst pressure to be recorded - Requirements: Burst pressure > 60 bars, start in cylinder sidewall, remain in one piece	
Design qualification tests - gunfire test	18f	10	Yes	- Pressurize to 20bars air/nitrogen - 0.30cal armour-piercing, approximately 2800feet/sec - Impact in sidewall, 45dgr, exit through sidewall if possible - Distance < 50yards - Record openings size and placement - Requirement: No evidence of fragmentation failure	
Design qualification tests - bonfire test - vertical	18g1	11	No	- At least 2 cylinder to be fitted with std. valve - Filled with 10 kg LPG - Cylinder to be mounted vertically with lowest part 0,1m above the base for fire. - Fire generation law. FRP-1. Fire should envelop the whole cylinder. - Burn until the cylinder is totally vented. - Time/pressure readings every 30sec. - Requirements: No violent behavior like burst or fragmentation allowed.	The intrinsic safety of this product is related to the fact that gas ventilation through the cylinder wall will happened during fire exposure after initiation time approximately as for a PRD-element, thereby eliminating the risk of cylinder burst, even with a malfunctioning PRD-element
Design qualification tests - bonfire test - horizontal	18g2	11	No	- 1 cylinder to be fitted with std. valve - Filled with 10 kg LPG - Cylinder to be mounted horizontally with lowest part 0,1m above the base for fire. - Fire generation law. FRP-1. Fire should envelop the whole cylinder. - Burn until the cylinder is totally vented. - Time/pressure readings every 30sec. - Requirements: No violent behavior like burst or fragmentation allowed.	The intrinsic safety of this product is related to the fact that gasventilation through the cylinder wall will happened during fire exposure after initiation time approximately as for a PRD-element, thereby eliminating the risk of cylinder burst, even with a malfunctioning PRD-element
Design qualification tests - cylinders for liquifed gas....	18g3	NA	Yes	XXX	Covered by 18g1 and 18g2
Design qualification tests - cylinders for non-liquified gas..	18g4	NA	Yes	XXX	Cylinder to be used for LPG

This colour represents qualification tests.

Item name	FRP-1, 178.AA-X	ISO/DIS 11439, sec. 8.5.x	Equal to original FRP-17	Standard description	Comments
Design qualification tests - droptest cycled	18gA01	9	No	- 50% filled with water. Std valve to be used. - 10 drops from 1.2m at concrete plate or similar - Drop sequence: Twice in the following five positions, giving the total of ten drops: (1) vertically onto the bottom end, (2) 45dgr onto the bottom end, (3) horizontally, (4) 45dgr onto the valve end, (5) vertically onto the valve end - Requirement: 1 cylinder to withstand 18e (burst) and 1 to withstand 18d1 (ambient cycle)	law CEN 12245 and ISO11119-3
Design qualification tests - flawed cylinder test	18gA02	8	No	- Two flaws: Length=5 times composite thickness at cyl. part. Depth = 40% of composite thickness. One longitudinal and other transverse in the central part along two planes forming an angle of 120dgr. - Requirement: 1 cylinder to withstand 18e to 40bars (burst), 1 cylinder to withstand 18d1 (ambient cycling) to 5000 cycles.	law CEN 12245 and ISO11119-3
Design qualification tests - permeability test	18gA03	12	No	- Proof test with water (test no. 4) - 1000 cycles with WATER, 1-20 bar. - Weigh empty cylinder - pressurise cylinder with 10 kg LPG. To be kept for 28 days. No refilling to be done. - Check for leakage with AGA leakage foam. - Weigh cylinder at day 0, 7, 14, 21 and 28. - Weigh empty cylinder after test. - Requirement: Maximum loss of weight rate q < 0,25 (ml/h/L). V=23L, 15dgrC propane, 1 bar => 1,874g/L => q = 1,874E-3g/ccm * 0,25ccm/h/L * 23L q = 0,011g/h = 7,4g/ 28d The calculation should be modified so that the difference between empty weight before and after test is not integrated in the loss of weight rate.	law CEN 12245 and ISO11119-3
Design qualification tests - Qualification test results	18h	NA	Yes	XXX	

DOT-E 12706

(Revision DRAFT TEXT 13)

Expiration date: XXXXXXXX, (For renewal, see 49CFR § 107.109)

Secrecy: Sec. 7. "Safety control measures" must not be distributed by others than the grantee

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1) Grantee / manufacturer

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2) Purpose and limitation

a) This exemption authorizes filling, transportation, use and service in commerce of certain materials described in paragraph 6 below, in non-DOT specification cylinders used both in the leisure market (barbequing, heating etc.) and by professional consumers (roof-workers etc). This exemption provides no relief from the Hazardous Materials Regulations (HMR) other than as specially stated herein.

b) The safety analyses performed in development of this exemption only considered the hazardous and risks associated with filling, transportation, use and service in commerce.

3) Regulatory system affected

49 CFR Parts 106, 107 and 171-180

4) Regulations from which exempted

49 CFR §§ 173.201, 173.302 and 173.304 in that a non-DOT specification cylinder is not authorized except as specified herein.

5) Basis

The exemption is based on the application of Raufoss Composites AS, dated April 20, 2001, submitted in accordance with §107.105 and the public proceeding therein.

6) Hazardous Materials (49 CFR 172.101)

Proper Shipping Name / Hazardous Material Description	Hazard class / Division	Identification Number	Packing Group
Propane	2.1	UN1978	NA
Butane	2.1	UN1011	NA
Liquefied petroleum gases	2.1	UN1075	NA
Hydrocarbon gas mixture, liquefied n.o.s.	2.1	UN1965	NA

7) Safety control measures

a) Packaging

Packaging described is a non-DOT specification cylinder
for the leisure market (cottages, caravans, barbecue) made up by

- a blow molded thermoplastic non-load sharing inner liner,
- fully wrapped with E-fibreglas / Thermoset composite and
- integrated in an injection moulded thermoplastic outer casing.
- watercapacity maximum 60 Litres (132Lbs)
- design pressure: 60bars (882psi)
- test pressure: 30bars (441psi)
- service pressure 20bars (294psi)

- Each cylinder must comply with the design calculations, drawings, material specifications and application for exemption on file with the Office of Hazardous Materials Exemptions and Approvals (OHMEA). In addition, **each cylinder must conform to DOT FRP–1 Standard, (rev.2; Febr 15 '87) <u>except</u> as follows**:

i) Heading: Basic requirements for fiber reinforced plastic (FRP) type 4FC composite cylinders.
(Comment: The cylinder has got a non-load sharing, blow molded, seamless thermoplastic liner instead of a aluminum liner)

ii) 178.AA-2: Type, size and test pressure
Type 4FC cylinder consisting of resin impregnated continuous filament windings in both longitudinal and circumferential directions only over thermoplastic liner; with a watercapacity less than 60 Liters (132Lbs); a defined service pressure 20bars (294psi), test pressure for hydrostatic proof testing at 30bars (441psi) and a required burstpressure (=designpressure) > 60bars (882psi).

iii) 178.AA-4: Duties of the inspector
(a) ...all materials conform to the provisions of FRP-1 and the exemption DOT-E 12706.

(b) For each rawmaterial batch, verify liner material to be within the specification in this exemption by analyses or obtaining the manufacturers certified analyses. A certification from the manufacturer is acceptable when verified by check analyses on a sample from every raw material batch. Verify conformance of filament and resin system components with the requirements in§178.AA-5

(d) The inspector shall verify conformance of completed cylinder with all requirements, including marking, condition of inside, threads and relevant process parameters.

(f) Inspect and confirm that the manufacturer store all basis data for the above mentioned parameters. This includes material details (see §§ (b)), batch test results (se §§ (d)), and individual process data (see §§ (e)).

iv) §178.AA-5 Authorized material and identification of material
(a) Liner material must be thermoplastic of blow molding quality

(c) Resin must be based on a thermoset resin as described in the material specifications. Resin system must be tested on sample coupons representative of the composite over-wrap in accordance with ASTM D-2344-67 for water boil test, and have minimum shear strength of 13,8MPa (2029psi) (Comment: law ISOXXXXXX).

v) 178.AA-6 Manufacture
(a) Liner: The thermoplastic liner shall be homogeneous, clean and correctly dimensioned. No defect that is likely to weaken the finished liner function is authorized. To determine liner properties, main process parameters defined by the manufacturer shall be continuously monitored and logged.

(b) Composite cylinder must be manufactured from a thermoplastic .... (text as FRP-1) .... temperature profile. No defect that is likely to weaken the finished cylinder appreciably is acceptable.

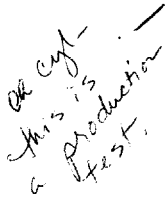
(d-2) Composite cylinder lot size: ...(text as in FRp-1)... same cylinder specification.

vi) 178.AA-7 Wall thickness
(a) Liner wallthickness shall be within tolerances specified in technical base for the product (= drawings).

vii) §178.AA-8 Openings
(c) If using tapered threads, the connection must be secured with a suitable tightening fluid. If using cylindrical threads, the integrity of the threads, cylinder neck and boss/liner attachment shall be tested by applying 1,5 times the force specified in **ASTM D XXXX (TBD)** or by the manufacturer for the relevant thread, resulting in no permanent damage to the threads, neck or boss/liner.

viii) §178.AA-9 Thermal treatment
(a) Not applicable, due to the use of a non-load sharing thermoplastic liner.

ix) §178.AA-11 Nondestructive tests
(a-1) Hydrostatic test: By water-jacket, air/gas-jacket, vision system or equivalent method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1% in the range of 80%-120% of test pressure. Expansion gauge must permit reading of total expansion to an accuracy of 1 percent of the water capacity.



(a-2) ....is calibrated on regular basis.

(a-3) .... to insure complete expansion.

(a-4) Each cylinder must be tested to at least 30 bars.

x) §178.AA-12 Destructive tests
(a) During start of production one cylinder taken from approximately every 200 cylinder shall be controlled for main dimensions (including wall thickness), weight and integrity of the boss connection to liner. The sample rate may be decreased in steps to 1/5000 cylinders based on a skip-lot system and OK results.

xi) (b) Cycling test. One cylinder taken random out of each 1000 cylinders must be subjected.....

xii) §178.AA-15 Marking
(a) Each cylinder must be permanently marked with in accordance with 49 CFR §178.51.

xiii) §178.AA-16 Inspector's report
(a) The inspector must prepare a report that is clear, legible and covers the relevant parts and legally binding text detailed in the following forms: (see forms in FRP-1, §178.AA-16 Inspector's report).

xiv) §178.AA-18 Design Qualification Tests
(b) Design change
.....in water capacity. Without changing the cylinder water capacity, an increase up to 50% in material thickness for structural related components (i.e. liner, composite overwrap, outer protection) may be implemented, resulting in he cylinder to be considered a equal product.

(g) Bonfire test
....until venting is completed. Test results are not acceptable if any violent behavior similar to burst or fragmentation is seen. (Comment: The intrinsic safety of this product is related to the fact that gasventilation through the cylinder wall will happened during fire exposure after initiation time approximately as for a PRD-element, thereby eliminating the risk of cylinder burst, even with a malfunctioning PRD-element)

xv) **(Additional Tests, not covered in FRP-1)**
AT01: Drop test – (In ISO11119-3 and CEN 12245). Two cylinders shall be filled with water to the weight equal to maximal service content. They shall be dropped from the height 1.2m onto a smooth, non-flexible surface (steel, concrete etc.) twice in the following five positions, giving the total of ten drops: (1) vertically onto the bottom end, (2) 45dgr onto the bottom end, (3) horizontally, (4) 45dgr onto the valve end, (5) vertically onto the valve end. Visual damages should be noted after each drop. After dropping, one cylinder shall withstand the ambient pressure cycling test, while the other cylinder shall withstand the burst test.

AT02: Flawed cylinder test – (In ISO11119-3 and CEN 12245). Two cylinders shall be prepared with cuts into the composite approximately in the following manner: Two flaws on each cylinder: Width = 1mm, length = 5 times the composite thickness, depth = 40% of the composite thickness. One cut to be longitudinal and other transverse in the cylindrical part along two planes forming an angle of 120dgr. One cylinder shall withstand the ambient pressure cycling test to 5000 cycles, while the other cylinder shall withstand the burst test to twice the service pressure.

AT03: Leak- and permeability test – (In ISO11119-3 and CEN 12245). Two cylinders shall be pressure cycled 1000 cycles to service pressure, weighed empty, filled with maximum amount of gas allowed in service (example: LPG => approximately 83% of the watercapacity), placed in a stabile, ambient environment, weighed after 1/7/14/21/28 days, emptied and weighed empty after testing. Requirement: Maximum loss of weight rate q < 0,25 (ml/h/L water capacity). The calculation should be modified so that the difference between empty weight before and after test is not integrated in the loss of weight rate.

(h-2) Qualification Test Results. A report of all tests for each design qualification, describing test setup, procedure and results must be submitted to the OHMT. This report must include at least the relevant parts of the form "Basic Cylinder Design Information, Dimension, material and pressure data".

(------- end of § 7 Measures and control, **a**) Packaging -------)

b) Testing – Every 5 years, each cylinders must be re-inspected and proof tested to 30 bars in accordance with §173.34e as prescribed for DOT 4BA specification cylinders. If statistics from testing the first 5000 cylinders shows no significant change in cylinder properties, the retest interval may be extended to 10 years or more. **The following exemptions are valid**:

i) §173.34e-3 Visual inspection.
The outer casing may only be removed or replaced by personnel authorized by the manufacturer. The outer casing and the non-protected composite areas only, shall be investigated with strong backlight to decide (1) approval, (2) further testing or (3) scrapping in accordance with the below table.

Defect / damage	Description	Rejection limit – it's OK if all the below is confirmed	Action if not OK
Abra-sion	Friction causing reduction of material thickness.	• Cracks in outer casing are not penetrating the total wall thickness of the casing.	• The casing should be removed and the composite cylinder investigated iaw these instructions
		• No holes from sharp objects (nail, spike, "knifeedge") go more than 1mm into the composite material.	• Cylinder to be scrapped
		• No impregnated fibertows are completely cut.	• Cylinder to be scrapped
		• If delaminated between the composite and liner (darker shadow), this area should not be wider than approximately 30% of the total cylinders surface.	• Cylinder to be scrapped
Cuts	Contact with sharp objects causing visible cuts into the composite.	• As for abrasion.	• As for abrasion.
Impact	Impact damage: Cracks or roughened surface on outer casing or open composite area.	• As for abrasion.	• As for abrasion.
Heat or fire damage	Deformed shape in thermoplastic casing or boss due to heat	• There are no areas showing melted plastics on the outer casing.	• The casing should be removed and the composite cylinder investigated iaw these instructions
Foreign particles	Foreign particles, for example between outer casing and composite material.	No foreign particles are present that • are expected to not be removed in the washing process • may damage deeper than 1 mm into the composite.	• Washing/cleaning to remove the particles.
Other defects	Visual details that appears to be not normal or that may lower the level of safety.	If in doubt, contact manufacturer or other certified persons	• Dependent on the situation

(Comment: Significant foreign particles should lead to cleaning the cylinder internally with air preferred before water. Corrosion is not possible, so internal investigation is not required).

Repair of rejected cylinders is not permitted.

c) Operational controls – Not applicable

8) Special provisions

a) A person who is not a holder of this exemption who receives a package covered by this exemption may re-offer it for transportation provided no modifications or changes are made to the package and it is re-offered for transportation in conformance with this exemption and the HMR.

b) A current copy of this exemption must be maintained at each facility where the package is manufactured.

c) The cylinders are authorised for the use described in this exemption section 2 and 6.

9) Modes of transportation authorised

When filled, motor vehicle, rail freight and cargo vessel only.

10)Modal requirements

A copy of this exemption must be carried aboard each cargo vessel used to carry large amounts of packages covered by this exemption.

11)Compliance

Failure by a person to comply with any of the following may result in suspension or revocation of this exemption and penalties prescribed by Federal Hazardous Material Transportation Law, 49 U.S.C. 5101. et seq:

All terms and conditions prescribed in this exemption and the Hazardous Material Regulation, 49 CFR Parts 171-180

Registration required by 107.601 et seq, when applicable.

Each "Hazmat employee", as defined 49 CFR 171.8, who performs a function subjected to this exemption, must receive training on the requirements and conditions of this exemption ion addition to the training required by §§172.700 through 172.704.

No person may use or apply this exemption, including display of it's number, when the exemption has expired or is otherwise no longer in effect.

12)Reporting requirements

The If aware of incidents involving loss of packaging contents or packaging failure, the holder of this exemption must report this in writing to the Associate Administrator for Hazardous Material Safety (AAHMS) as soon as practicable.